

Mom's Garden

Suggested Grades

6, 7

SD Mathematics Strand & Standard (Primary for Task)

Measurement

7.M.1.2

Students, when given the formulas, are able to find circumference, perimeter, and area of circles, parallelograms, triangles, and trapezoids (whole number measurements).

Task Summary

Students calculate the cost of fencing a garden plot based on accurate calculation of area and perimeter.

Time and Context of Task

1-2 class periods, when they have learned to use formulas correctly

Materials Needed

Worksheet with the formulas needed, paper and pencil

Authors and Lead Teacher for This Task

Jean Gomer, Deubrook Area Schools (Lead Teacher for the Task)

Diana McCann, Bon Homme High School



Mom's Garden

You and your friend are going to make a new garden for your mom. You must make it one of the following shapes:

- An 11 ft by 11 ft square
- A 10 ft by 12 ft rectangle
- An isosceles trapezoid with bases which are 9 ft and 21 ft long, height of 8 ft, and ends which are 10 ft.
- A circle with radius 6 ft

Using the given formulas for perimeter and area decide which garden shape would have the least cost per square foot for fencing. The cost of the fencing is \$8.00 per running foot. Prepare a written justification of your choice that includes the area, perimeter and cost per square foot of fencing for each shape.

FORMULAS:	Perimeter Circumference	Area	Variables
Trapezoid	$P = b_1 + b_2 + s + s$	$A = 1/2h(b_1 + b_2)$	H = height; s = side, b_1 = base 1; b_2 = base 2
Square	$P = 4s$	$A = s^2$	S = length of side
Rectangle	$P = 2(l + w)$	$A = lw$	L = length; w = width
Circle	$C = \pi d$	$A = \pi r^2$	R = radius; d = diameter



CONTENT STANDARDS

Primary Standard

Strand Name: Measurement

SD Goal: Students will apply systems of measurement and use appropriate measurement tools to describe and analyze the world around them.

Indicator: Apply measurement concepts in practical applications.

Standard: 7.M.1.2. Students, when given the formulas, are able to find circumference, perimeter, and area of circles, parallelograms, triangles, and trapezoids (whole number measurements).

Supplemental Standards

Strand Name: Geometry

SD Goal: Students will use the language of geometry to discover, analyze, and communicate geometric concepts, properties, and relationships.

Indicator: Use properties of geometric figures to solve problems from a variety of perspectives.

Standard: 7.G.1.2. Students are able to identify and describe elements of geometric figures.

Strand Name: Algebra

SD Goal: Students will use the language of algebra to explore, describe, represent, and analyze number expressions and relations that represent variable quantities.

Indicator: Interpret and develop mathematical models.

Standard: 7.A.3.2. Students are able to model and solve multi-step problems involving rates.

NCTM Process Standards

Problem Solving: Solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; monitor and reflect on the process of mathematical problem solving.

Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Connections: Recognize and apply mathematics in contexts outside of mathematics.

Representation: Use representations to model and interpret physical, social, and mathematical phenomena.

Problem-Solving Strategies

- Drawing pictures, graphs, and tables
- Simplifying the problem

ASSESSMENT TOOLS

Task Rubric

	Advanced	Proficient	Basic	Below Basic
Content Standard 7.M.1.2: Students, when given the formulas, are able to find circumference, perimeter, and area of circles, parallelograms, triangles, and trapezoids (whole number measurements).	Using the given formulas, students are able to precisely find the area and perimeter of all the figures and label them with the correct units.	Students accurately find the area and perimeter of all figures with whole number measurements to whole number accuracy and label them with correct units.	When given the formulas, students accurately find the area and perimeter of most figures with whole number measurements and label them with correct units.	Students do not accurately find the area/perimeter of the required figures.
Content Standard: 7.G.1.2: Students are able to identify and describe elements of geometric figures.	Students can correctly identify and use any of the four geometric figures and its associated formula.	Students can correctly identify any of the four geometric figures and its associated formula.	Students can correctly identify some geometric figures and their associated formula.	Students do not correctly identify a geometric figure or its associated formula.
Content Standard: 7.A.3.2: Students are able to model and solve multi-step problems involving rates.	Students can correctly find the rate (cost per square foot) and make the best choice of shape.	Students can correctly find the rate (cost per square foot) for most shapes and make a good choice of shape.	Students can correctly find the rate (cost per square foot) for some figures and makes a good choice of shape based on their calculations.	Students incorrectly find the rate (cost per square foot) or make a poor choice of shape.
NCTM Process Standard: Communication Communicate mathematical thinking clearly and coherently to peers, teachers, and others.	There is a clear, effective justification detailing how and why the choices were made.	There is a clear justification of how the problem is solved.	There is an incomplete justification of how the problem is solved. It may not be clearly presented.	There is no justification of the solution, the justification cannot be understood, or is unrelated to the problem.

**Seventh Grade Measurement
Performance Descriptors**

Advanced	Seventh students performing at the advanced level: <ul style="list-style-type: none"> • use perimeter, circumference, and area formulas to solve problems; • select, use, and convert appropriate units of measure to solve problems; • draw and use grids to estimate the area of a shape.
Proficient	Seventh grade students performing at the proficient level: <ul style="list-style-type: none"> • select and use the appropriate formula to find the perimeter, circumference, and area of a shape; • select and use appropriate units of measure; • convert units of measure.
Basic	Seventh grade students performing at the basic level: <ul style="list-style-type: none"> • given the formula find the perimeter and area of a shape; • select appropriate units of measure.

**Seventh Grade Measurement
ELL Performance Descriptors**

Proficient	Seventh grade ELL students performing at the proficient level: <ul style="list-style-type: none"> • explain and use formulas in measurement situations; • create scale drawings; • solve problems accurately involving standard two-dimensional shapes; • read, write, and speak the basic language of measurement.
Intermediate	Seventh grade ELL students performing at the intermediate level: <ul style="list-style-type: none"> • use formulas in measurement situations; • use measurement terms to explain how to solve problems; • give simple oral or written responses to directed questions on topics presented in class.
Basic	Seventh grade ELL students performing at the basic level: <ul style="list-style-type: none"> • select and use appropriate measurement tools for a variety of situations; • recognize and use basic measurement terms; • respond to yes or no questions and to problems presented pictorially or numerically in class.
Emergent	Seventh grade ELL students performing at the emergent level: <ul style="list-style-type: none"> • recognize and name measurement tools; • give simple oral responses to directed questions on topics presented in class; • copy and write measurement symbols; • imitate pronunciation of numbers and measurement terms; • use non-verbal communication to express measurement ideas.
Pre-emergent	Seventh grade ELL students performing at the pre-emergent level: <ul style="list-style-type: none"> • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

MOM'S GARDEN

Student Work Samples

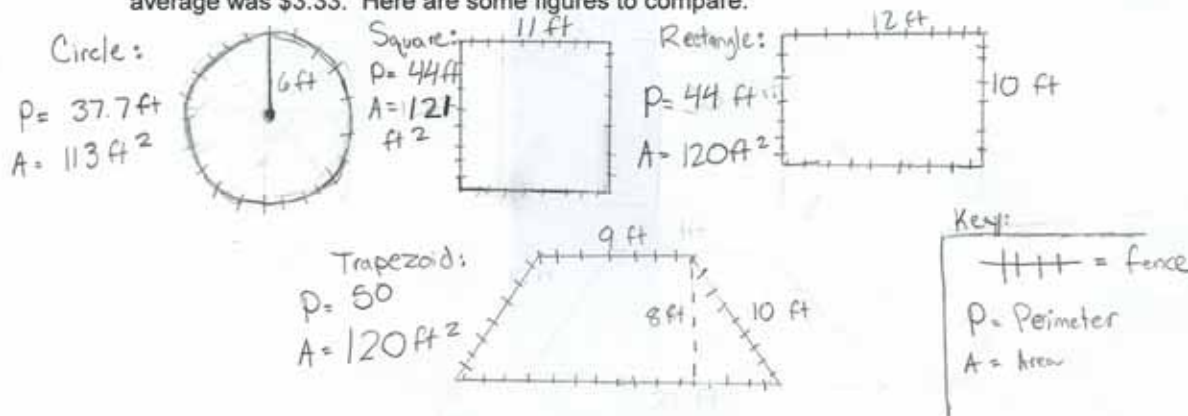


As you examine the samples, consider the following questions:

- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

Student Work Sample #1

For this problem, the best shape for the answer I found was the circle. It had a measure of 113 ft squared for the area and the perimeter is 37.7 ft. The cost per square foot of fencing was \$2.67. The square would have been next for the most economical cost with \$2.91 per sq. ft. The measurements were 121 ft squared for area and a 44 ft. perimeter. The rectangle was just behind the square with the cost of \$2.93 per square ft, and measurements 120 ft squared for the area, and 44 ft for the perimeter, like the square. The shape that cost the most and had the worst rate for the dollar amount per square ft was the trapezoid. The area was 120 ft squared, the perimeter was 50 ft, and the cost average was \$3.33. Here are some figures to compare.



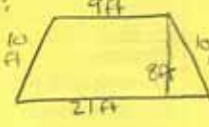
The way I found these numbers and amounts for the shapes was that I first found the area and perimeter of each shape using what I had already learned and the formulas on the sheet of instructions. Then I multiplied the perimeter times \$8.00 for the cost of fencing to find the total cost of fencing. To find the average cost per square ft of garden, I used the amount of money for fencing and divided that by the area. I then compared the amounts of each shape to the others. This is

how I found the area, perimeter, cost of fencing, and cost per square ft of fencing.

Using all of this information, I found the circle was the best use of money and had the most area for cost. I chose the circle as the most cost effective shape for a garden because it had the least cost per square ft. It didn't have as much area as the others but it was most economical in fencing.

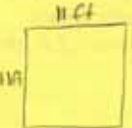
Scratch paper attached to the written justification:

Trapezoid:



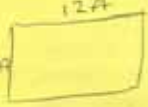
$A = 120 \text{ ft}^2$
 $P = 50 \text{ ft} = \$400.00 \text{ for fencing} = \3.33

Square:




$A = 121 \text{ ft}^2$
 $P = 44 \text{ ft} = \$352 \text{ for fencing} = \2.90 per sq. ft

Rectangle:



$A = 120 \text{ ft}^2$
 $P = 44 \text{ ft} = \$352 \text{ for fencing} = \2.93 per sq. ft

Circle:



$A = 113 \text{ ft}^2$
 $C = 37.7 \text{ ft} = \$301.60 \text{ for fencing} = \2.67 per sq. ft.

Looking at Student Work – Instructor notes and rating for work sample #1:

Based on the Rubric, I would rate this student's work as advanced. The student used the formulas to find the areas, the perimeters, and cost per square foot and labeled them correctly. In addition there is a clear, effective justification of how the work was done and the choices made.

Student Work Sample #2

Perimeter Circumference

trapezoid - $P = 9\text{ft} + 21\text{ft} + 10 + 10 = 50$

square - $P = 4 \times 11 = 44$

rectangle - $P = 2(10 + 12) = 44$

circle - $C = \pi \times 12 = 37.69$

Area

trap. $\frac{1}{2} \times 8(9 + 21) = 120$

square - $11^2 = 121$

Rectangle - $10 \times 12 = 120$

circle - $\pi \times 6^2 = 113.09$

Cost

trapezoid - \$400

square - \$352

Rectangle - \$352

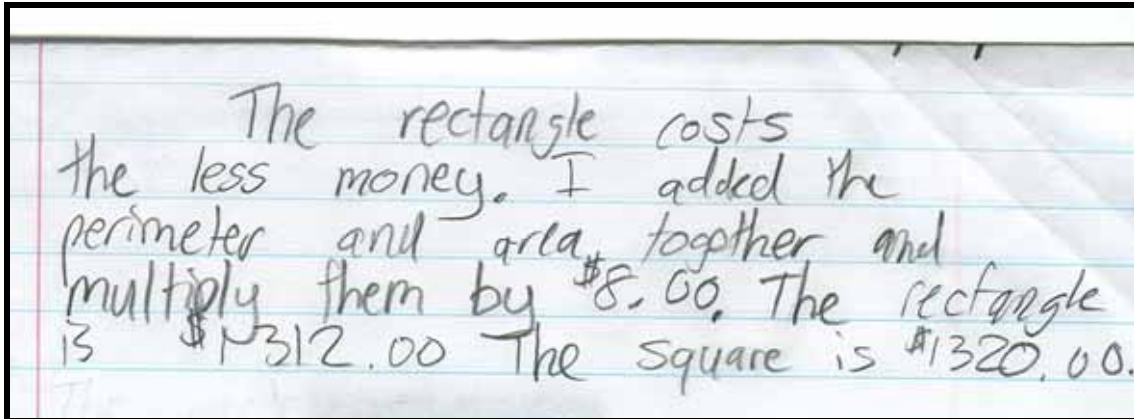
Circle - \$301.52

I picked the square, because it has the most area because you take 11^2 and you get 121. The perimeter is $4 \times 11 = 44$ the 2 biggest perimeter. The cost is \$352 the 2/3 most. I think the square is the most efficient.

Looking at Student Work – Instructor notes and rating for work sample #2:

I would rate this work as high basic or low proficient. The student correctly calculated the area, perimeter and cost of fencing for each shape. The student did not find the cost per square foot, and incorrectly chose the square as the most efficient shape. The justification is clearly expressed, even though it is incorrect.

Student Work Sample #3



Looking at Student Work – Instructor notes and rating for work sample #3:

I would definitely rate this student below basic. No calculations are shown, and the explanation of what was done indicates that the student does not understand the concepts at all.

INSTRUCTIONAL NOTES

Author comments

This was used as a culminating activity after a unit on area and perimeter. It was the first performance task activity that this particular group of 7th grade students had done in my class. The student's had no experience with using a rubric to guide their presentation of the work done. In spite of this, about 20% did work that was in the advanced category, about 70% did work similar to Student #2 (low proficient to high basic), and 10% were below basic. Later performance on similar tasks showed a more accurate reflection of their grasp of the content.

Task Extension

I also used this task with a group of 8th graders and asked them to consider other factors than just the cost per square foot. I did not give them other factors to consider, and the students came up with things like appearance of the garden, accessibility of the plants for weeding, etc. as rationale for their choices.

Resources

SD Mathematics Content Standards

<http://www.doe.sd.gov/contentstandards/math/index.asp>

SD Assessment and Testing

<http://www.doe.sd.gov/octa/assessment/index.asp>

The National Assessment of Educational Progress (NAEP)

<http://www.doe.sd.gov/octa/assessment/naep/index.asp>

National Council of Teachers of Mathematics

<http://nctm.org/>

Looking at Student Work

<http://www.lasw.org/index.html>